

EXPERIENCE OF TCC IBRAE RAN IN SCIENTIFIC AND TECHNICAL SUPPORT AND RADIATION EMERGENCY RESPONSE



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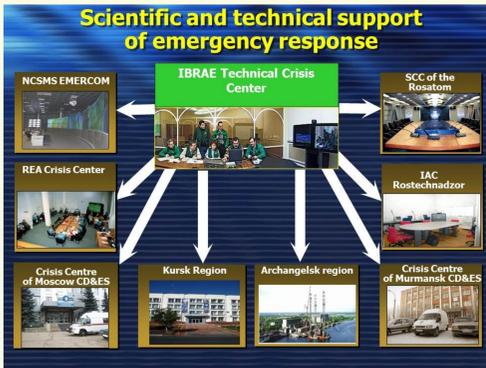
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1. Introduction.

The Technical Crisis Centre (TCC) has been created and started to function in IBRAE RAN in 1996. Its primary goals are:

- Evaluate and forecast the basic characteristics of the source of emergency radioactive release;
- Predict environmental contamination taking into account the radiation monitoring data;
- Assess and forecast public exposure doses;
- Elaborate recommendations on public and environmental protection;
- Assess the efficiency of protective measures and optimize them for specific conditions taking into account radiological, economic and social conditions.

TCC works in a round-the-clock mode, its experts carry out engineering, scientific and technical support of the National Center on Management in Crisis Situations (NCMCS) of the EMERCOM of Russia, the Situational Crisis Center (SCC) of Rosatom and the Crisis Centre of Concern "Rosenergoatom".

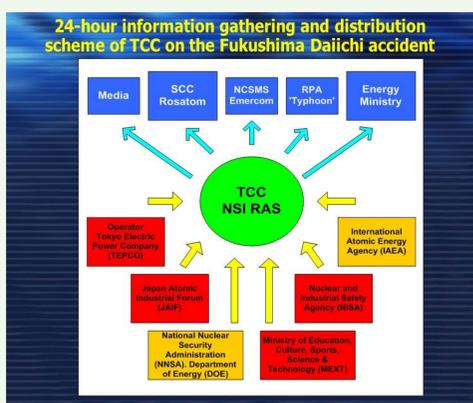


2. Objectives.

At 13 o'clock on March, 11th 2011 (Moscow time), right after the first news reports about catastrophic earthquake, a tsunami at the East coast of Japan caused by it, and problems with cooling of the nuclear reactors of NPP "Fukushima-1" caused by this cataclysms, TCC IBRAE RAN in a body has been brought into a higher state of readiness.

According to the regulations and the additional order of the Government experts of the TCC should provide support of NCMCS, of the EMERCOM of Russia and SCC of Rosatom in the following directions:

- Predict evolution of the situation at this NPP (in coordination with Rosatom);
- Predict the radiation situation in vicinity of Fukushima Daiichi and Daini NPPs in case of unfavorable scenarios of situation evolution;



• Predict the radiation situation in the territory of the Russian Federation in case of unfavorable scenarios of the Japanese accident evolution (in coordination with SPA "Typhoon").

• Inform the media and the public and provide the actual, topical and scientifically valid information about the incident and its consequences for the human and environment.

3. Discussion.

Great amount of information in following areas has been collected, processed and analyzed during the TCC work in the emergency mode:

- Status of the Fukushima Daiichi units, reactors and spent fuel ponds (TEPCO, JAIF, IAEA) (three times a day);
- Radiation monitoring data on the power plant site, in Japan, on the territory of Russian Far East (MEXT, NISA, DOE, Hydrometeorological centre of Russia, Emercom);
- Radioactive contamination of soil, sea water and food (MEXT, NISA).

A possibility of adverse development of the accident in case of melting of the active zone and an exit of a considerable part of radionuclides from 3 reactors of NPP "Fukushima-1" and from fuel storage of the 4th unit into environment, has been calculated by means of computer code SOCRAT, developed in IBRAE. The results of calculations were used for the quantitative estimations defining possible time dynamics of development of the accidents.

Generally, results of this calculations testified to quite good conformity of dynamics of processes estimations and the moments of approach of the key events, which have led to heavy radiating consequences on NPP area and beyond its limits.

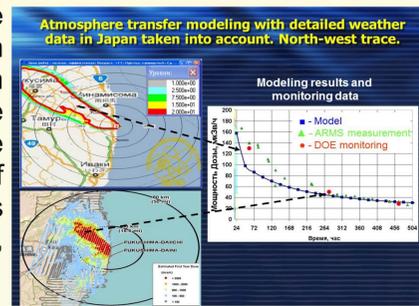
The first forecast of possible radiation situation around Vladivostok, in the assumption of the adverse scenario of succession of events on 4 blocks of NPP "Fukushima-1" and advancement of a radioactive cloud towards Primorski Krai, has been prepared in the evening on March, 11th, 2011 by TCC experts, i.e. long before radioactive pollution of considerable territories of Japan. Results of these calculations, which have been carried out by means of computer code NOSTRADAMUS



developed in IBRAE RAN, have shown that at all possible conservative assumptions (up to meltdown of fuel of 3 reactors and in fuel storage on 4th unit, intensive precipitations around Vladivostok's area, etc.) the radiation exposure of the population of the city will not exceed 10 mSv for the first year, i.e. actions for population protection won't be required.

The next days and months similar calculations were spent as well for various sites in territory of Japan.

The executed calculations allowed estimating possible activity of powerful emission of radioactive substances into atmosphere from 2nd unit of NPP "Fukushima-1" on March, 15th, 2011. Results of these estimations, in comparison with the calculations of total activity of emission presented in various publications from NPP "Fukushima-1", are presented below.



I-131 and Cs-137 release to the atmosphere estimation

Nuclide	Discharge estimation, Bq			Release for the Chernobyl accident
	Release (NSI RAS) March 15	NISA	NSC	
I-131	2*10 ¹⁷	1,3*10 ¹⁷	1,5*10 ¹⁷	1,8*10 ¹⁸
Cs-137	3*10 ¹⁶	6,1*10 ¹⁵	1,2*10 ¹⁶	8,5*10 ¹⁶
Bqero	1,4*10 ¹⁸	3,7*10 ¹⁷	6,3*10 ¹⁷	5,2*10 ¹⁸

According to preliminary estimations of NISA, NSC and TCC NSI RAS Fukushima Daiichi accident corresponds to *level 2* of the INES.

As known, due to Chernobyl accident in 1986 the area of territories with radioactive contamination by ¹³⁷Cs above 0.56 MBq/m² in Russia, Ukraine and Belarus was 10260 km². Such considerable territories of radioactive contamination zones demanded to create simple and effective techniques of estimation of doses of radiation exposure on

population by using the simplest value to measure - the γ-radiation dose rate on the open air [IAEA, TECDOC-516, 1989]. It has been decided to use results of dose rate measurements of the 15th day after the accident as a normalizing indicator.

Fukushima accident has also led to radioactive contamination of large territories in Japan. As well as in case of Chernobyl accident, radiation consequences of explosions on the nuclear reactors of "Fukushima-1" NPP in the first days and weeks were defined by isotopes of iodine and tellurium (especially ¹³²I, ¹³¹I and ¹³²Te), and then the main contribution in the radiation exposure was produced by ¹³⁴Cs and ¹³⁷Cs. Therefore it is possible to use the experience of reconstruction of radiological consequences of Chernobyl accident for an estimation of possible doses of an external and internal radiation of the population due to "Fukushima-1" NPP accident, for the settlements in prefectures Fukushima and Ibaraki.

The methodology of an estimation of possible doses of external and internal radiation exposure of the population was developed on basis of preliminary calculation with use of separate modules of the code NOSTRADAMUS. Calculations were made separately for Northern, North-West and Southern radioactive traces which emerged after the Fukushima accident. As the initial data for calculations the information from web-sites www.bousai.ne.jp, www.mext.go.jp, www.tepco.co.jp, www.jaea.go.jp, www.cms.pref.fukushima.jp and some additional publications were used.

The most attention was given to estimations of possible doses of external radiation of the population from a radioactive cloud and from radionuclides which dropped out on a soil surface. Possible doses of internal radiation (thyroid gland and effective dose) were estimated only for inhalation intake of radioactive substances. The ingestion intake of radionuclides was not taken into account as a factor of radiation exposure of local population, as the administrative measures were accepted timely.

Results of calculations were normalized on the dose rate of γ-radiation on the open air for March, 26th, 2011 (15th day after shutdown of reactors of "Fukushima-1" NPP) that has allowed receiving the reasonable estimations of annual radiation doses of people in the other settlements within Northern, Northwest and Southern traces of radioactive clouds after the Fukushima accident.

Estimations of radiation exposure doses, normalised on the dose rate of gamma radiation at level 1 mkSv/h on March, 26th 2011

Normalised doses	Northern trace	Southern trace	North-Western trace
External radiation exposure from the cloud, mSv	0,041	0,028	0,0067
Internal radiation exposure by inhalation:			
Thyroid gland, mGy	0,65	2,0	0,39
Effective dose, mSv	0,050	0,18	0,037
External radiation exposure from ground contamination, mSv, for:			
2 days	0,11	0	0
10 days	0,49	0,49	0,34
1 year	4,0	2,2	2,6

Thus on the basis of generalisation theoretical considerations, accumulated experience and direct experimental data it was possible to receive a simple technique of an estimation of doses of external and internal radiation exposure of the people living in a zone of radioactive contamination after the Fukushima accident.

The accident on NPP "Fukushima-1" has caused negative reaction in society and has demanded to inform the population on a real situation at the station and possible consequences of this incident promptly. Experts TCC were actively involved with the press-services of the EMERCOM of Russia and Rosatom for this work. This activity has played a great role in objective public informing and has lowered social tension in the Far East Russia.

4. Conclusions.

The following tasks were successfully accomplished by the TCC specialists during the emergency work on the Fukushima Daiichi accident:

- determination of the radiation risks for the population of Russian Far East region;
- prediction the dynamics of the emergency situation on the units of the NPP "Fukushima-1";
- estimation of the discharge sources into the environment;
- to create the methodical approaches which have allowed promptly to estimate a dose of an external and internal radiation of people, living in various regions of Japan, proceeding from dose rate of gamma-radiation on the open air for 15 days after shutdown of NPP reactors;
- Supply the media and the public with actual, topical and scientifically valid information about the incident and its consequences for the humanity and environment
- provide the 24-hour scientific-technical support for the NCSMS Emercom and SCC Rosatom